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# INNOVATIVE PROBLEM SOLVING IN USAF OFFICER

# PME CURRICULUM

by

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# Contents

## *Abstract*

Innovative problem solving is a critical cognitive skill that leaders need to tackle the complex and ill-defined problems inherent in leadership and dynamic organizations.  In an era of rapid technological and informational innovations, Air Force leaders find themselves in a constantly changing military and world environment.  Air Force leaders must be capable of innovative thought and action in order to deal with the ambiguous, complex, and novel problems this changing environment generates.  Although creative problem solving is often perceived as a rare talent, it is a cognitive skill and innate ability that can be nurtured, developed, and stimulated through education and training.  This research paper examines the following two questions: (1) Are USAF officer professional military education (PME) curricula at in-residence schools offering innovative strategies for solving problems? and (2) Along the PME continuum, is there a difference in what is offered in each school and is it appropriate for the level of the officer's experience?  A literature review of the following areas was conducted: the importance of innovative problem solving, problem solving and leadership, the acquisition of problem solving knowledge and skills, and the USAF officer PME curricula.

The research concluded that while Air Force PME does a good job of developing innovative problem solving skills at the primary officer levels, not much of an emphasis is placed on fine-tuning or expanding these skills at the middle and senior officer levels.  More research is needed to determine whether the curriculum at the middle and senior service schools should be expanded to include innovative problem solving.

# Chapter 1

# Introduction

*Still the question recurs "can we do better?" The dogmas of the quiet past are inadequate to the stormy present. The occasion is piled high with difficulty, and we must rise with the occasion. As our case is new, so we must think anew, and act anew.*

—Abraham Lincoln

Change is ubiquitous. The global environment, American society, and the United States military appear to be in a constant state of flux. Although change is generally viewed as a norm in the evolution of people and organizations, innovations in technology and information have produced unparalleled rates of change creating unique challenges for today's military leaders. Acknowledging the changing environment, the Chairman of the Joint Chiefs of Staff highlighted the need to transform military capabilities in Joint Vision 2020, his vision for the future of the military. In Joint Vision 2020 he envisioned, "The pace of technological change, especially as it fuels changes in the strategic environment, will place a premium on our ability to foster innovation in our people and organizations across the entire range of joint operations."[1] Reacting to those changes in the strategic environment requires armed forces composed of well-educated, motivated, and competent individuals capable of adapting to and meeting the challenges, complexities, and pace of future operations.[2] The Air Force recognizes that "it is in the imagination of our people that new concepts and technologies key to future aerospace operations will be born."[3] To meet the challenges of a dynamic environment and offer creative

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solutions to an array of complex problems, it would appear that innovative problem solving is an essential cognitive skill required of Air Force leaders today and in the future.

## Background and Definitions

Problem solving generally brings to mind the idea of solving a puzzle or tackling a complex or perplexing problem. In his book, *Flexible Thinking*, Jausovec noted most problems are categorized as either well-defined or ill-defined problems.[4] Well-defined problems are usually clearly formulated and have routine types of solutions for which criteria are available to test for correctness.[5] Ill-defined problems tend to be more complex, do not provide all the information necessary to solve the problem, and have less definite criteria for determining when the problem has been solved.[6] Well-defined problems can usually be solved using standard operating procedures and organizational guidelines, whereas ill-defined problems require creative problem solving.[7]

Problem solving is also a cognitive process. Educational systems from elementary schools to professional institutions impart knowledge and teach cognitive skills of which problem solving ability is considered one of the most important.[8] Baron placed problem solving in a much larger cognitive domain by stating, "Any thinking task may be viewed as solving a problem."[9] The ability to think differently—creatively—would seem to be an important skill in a rapidly changing environment.

Mumford, Whetzel and Reiter-Palmon indicated, "Creative thought occurs when people must solve novel, ill-defined problems."[10] Creativity is openness to new information, new perspectives, and making new connections.[11] The practical application of creative thought is defined as innovation.[12] The terms creative and innovative are used interchangeably throughout this study. While some of the literature differentiates between problem finding and problem

solving, for this study, problem solving is defined as a continual process of problem identification, problem solving, and implementing solutions.[13]

Innovative problem solving is an important characteristic of leadership. Mumford, Zaccaro, Harding, Jacobs and Fleishman posited organizations are characterized by complexity, change, and conflict; and leader performance ultimately depends on the person's ability to solve novel, ill-defined organizational problems.[14] Reisweber also noted fine-tuning of problem solving skills in Army leaders is key to success on the battlefield.[15] The effective application of creative problem solving strategies suggests a need to develop those cognitive and social skills and abilities needed to acquire the requisite expertise in problem solving. Mumford et al. concluded the capability of leaders to formulate and implement solutions to complex problems depends on a complex set of skills and the availability of requisite knowledge.[16] Acquisition of the necessary skills can be accomplished through training and experiences that include novel and challenging problems and are tailored to developmental needs.[17]

In a comprehensive review of creativity research, Puzzio, from the Center for Studies in Creativity, found growing competition in business and industry as a commonly cited reason for interest in the study of creativity.[18] He noted creativity has become key to corporate survival, and in order to remain competitive, organizations must incorporate creativity and innovation into all business functions.[19] He also surmised, "To tackle world-wide challenges, such as pollution, starvation, terrorism, and the threat of nuclear war, more energy must be devoted to training in creative thinking and problem-solving skills."[20]

Leadership development is an important component of Air Force officer professional military education (PME), and problem solving is found to varying degrees in the curriculum across the entire range of the continuum of education—from the Air Force Officer Accession and

Training Schools (AFOATS) to the Air War College (AWC).  As Air Force officers progress through their careers and encounter increasingly more complex and demanding leadership challenges, innovative problem solving would appear to be an important skill that should be developed throughout the curriculum.

## Purpose

The purpose of this paper is to examine how innovative problem solving is incorporated into the officer PME curriculum.  More specifically the following questions will be addressed:

1. Are USAF officer PME curricula offering innovative strategies for solving problems?
2. Along the PME continuum, is there a difference in what is offered in each school and is it appropriate for the level of the officer's experience?

A literature search was conducted to identify theoretical models and research in the following areas: innovative problem solving, problem solving and leadership, and the acquisition of problem solving knowledge and skills.  Information was also collected on the problem solving curricula provided in USAF officer PME schools.  The literature review and curriculum information were then used to analyze the questions posed above.

## Scope and Limitations

The scope of this paper was limited to examining the following officer PME schools: the Squadron Officer College, Air Command and Staff College, and Air War College.  Research was further limited to in-residence programs.

## Significance of Study

The need to focus on innovative problem solving is evidenced by an environment fraught with rapid change, uncertainty, and ambiguity.  Understanding and analyzing how officer PME

integrates the acquisition of problem solving knowledge and skills, and in particular innovative

methods, may help future leaders become more proficient problem solvers.

**Notes**

[1] *Joint Vision 2020*, (June 2000): 3.

[2] Ibid.*,* 7-14.

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[5] Norman Frederiksen, "Implications of Cognitive Theory for Instruction in Problem Solving," *Review of Educational Research* 54, no. 3 (Fall 1984): 366-7.

[6] Ibid., 366.

[7] Nancy A. Fontenot, "Effects of Training in Creativity and Creative Problem Finding Upon Business People," *The Journal of Social Psychology* 133 no. 1 (1993): 13.

[8] Frederiksen, 363.

[9] Jonathan Baron, *Thinking and Deciding,* (New York: Cambridge University Press, 1988), 43.

[10] Michael D. Mumford, Deborah L. Whetzel, and Roni Reiter-Palmon, "Thinking Creatively at Work: Organization Influences on Creative Problem Solving," *Journal of Creative Behavior* 31 no. 1 (First Quarter 1997): 9.

[11] Keith D. Denton, *The Toolbox for the Mind: finding and Implementing Creative Solutions in the Workplace* (Milwaukee: ASQ Quality Press, 1999), 8.

[12] Bob Filpczak, "It Takes All Kinds: Creativity In the Work Force,"*Training* 34 (May 1997): 32.

[13] Min Basadur, "Impacts and Outcomes of Creativity in Organizational Settings," in *Nurturing and Developing Creativity: The Emergence of a Discipline,* ed. Scott G. Isaksen et al. (Norwood, N.J.: Ablex Publishing Corporation, 1993), 279.

[14] Michael D. Mumford, Stephen J. Zaccaro et al., "Leadership Skills for a Changing World: Solving Complex Social Problems," *Leadership Quarterly* 11 no. 1 (Spring 2000): 11-35.

[15] Deborah Reisweber, "Battle Command: Will We Have It When We Need It?" *Military Review* 77 no. 5 (Sep-Oct 1997): 53.

[16] Mumford, Zaccaro et al., 23.

[17] Michael D. Mumford, Michelle A. Marks et al. "Development of Leadership Skills: Experience and Timing," *Leadership Quarterly,* 11 no. 1 (Spring 2000): 87-115.

[18] Gerard J. Puccio, "Why Study Creativity?" on-line, Internet, 11 November 2000, available from http://www.buffalostate.edu/~creatcnt/puccio_article.html

[19] Ibid.

[20] Ibid.

# Chapter 2

# Review of the Literature

*Continual change and the need to respond to it compels the commander to carry the whole intellectual apparatus of his knowledge within him. He must always be ready to bring forth the appropriate decision. By total assimilation with his mind and life, the commander's knowledge must be transformed into a genuine capability.*

— Carl von Clausewitz, *On War*

The complexities of warfare and exponential changes in the world environment are undoubtedly more complex than what Clausewitz encountered in his lifetime, yet his perceptions of military leadership in the nineteenth century appear to be timeless truisms. It is finely tuned knowledge, skills, and abilities that enable military leaders to effectively react to changes in a way that transforms the organization, environment, or battlespace to their advantage. Cognitive ability is important in leaders and the ability to problem solve is considered to be one of the most important cognitive skills.[1] Martinelli proposed a taxonomy of cognition and surmised, "Problem solving is 'the highest order skill' because, in solving problems, all thinking skills, including critical thinking and creativity, can be used, and complex problem solving usually involves a mix of rational and creative processes."[2]

According to Puccio, creative-thinking skills in conjunction with domain knowledge are a necessary combination of skills that "will enable individuals to produce novel and useful solutions to challenges that appear to have no immediate solution."[3] He goes on to say, "Knowledge about a particular domain is sufficient to solve problems that are straight forward;

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however, creative-thinking skills are required to solve more complex and open-ended problems."[4]

This chapter will review the literature and discuss the following concepts: the importance of innovative problem solving, problem solving and leadership, and acquisition of problem solving knowledge and skills.

## The Importance of Innovative Problem Solving

Change is pervasive in all facets of the organizational and global environment and the ability to think and act differently is vital to managing or adapting to changing environments.[5] Innovative problem solving is also a key factor in adapting to changing environments.[6] Problem solvers derive effective solutions from the following cognitive skills and abilities: inductive and deductive reasoning, divergent and convergent thinking, information processing skills, and verbal reasoning.[7] These are essential skills for ill-defined problems and enable an individual to better understand the problem and its parameters, facilitate the search and selection of effective solutions, monitor implementation of solutions through feedback, and adapt solutions to changing conditions.[8] Creativity theorist, J.P. Guilford, noted that of the mental processes involved in creative problem solving, divergent and convergent thinking were the most important.[9]

Divergent thinking is involved in the generation of a wide variety of ideas, whereas, convergent thinking is used to hone in on possible solutions. Other terms were found in the literature that described these same processes. Solomon equated divergent thought to the imaginative phase of creative problem solving and convergent thought to the practical phase.[10] She posited the imagination phase consisted of two fundamental concepts: (1) the ability to make new connections and (2) deferring judgment or allowing the mind to work without judging the

connections.[11]  Basadur used the ideation-evaluation process to explain the diverging and converging aspects of creative problem solving and noted they were both essential to creative problem solving.[12]  He indicated ideation is generating ideas without evaluation, and evaluation is applied judgment to select the best idea.[13]  He also emphasized that these processes were found in each phase of the problem solving process—problem finding, problem solving, and solution implementation.[14]

Changes in the environment present organizations with novel and ill-defined problems which necessitate the application of complex creative problem solving skills, and, significantly, "as the rate of global change increases, creative thought is likely to have greater impact on organizational performance."[15]  In fact, innovative problem solving is considered essential to an organization's effectiveness, competitiveness, and long-term survival.[16]  Basadur noted most organizations can improve with increased creativity, and conceptualized creativity in organizations as "a continuous finding and solving of problems and implementing of new solutions for the betterment of the organization and its members."[17]  He characterized problems in organizations as either more "programmed" or "nonprogrammed" in nature.[18]  Solutions to programmed problems entail applying prior job or school experiences and are based on judgment, logic, and learned processes that can be applied to similar situations.[19]  Nonprogrammed problems are usually less structured and more unpredictable, and solutions require additional skills such as problem sensing and anticipating, problem defining, environment scanning, and obtaining acceptance for and getting new ideas implemented successfully.[20]  In other words, imagination as well as sound judgment and logic are required for innovative problem solving.

Basadur noted traditional formal training in high schools, universities, and bureaucratic organizations generally address the more programmed type of problems.[21]  Thus, learners tend to learn formulas, problem types, and rules and procedures, which can inhibit the solving of nonprogrammed problems where initiative, imagination, and tolerance for ambiguity are important.  He went on to say "It is difficult for people to do strategic thinking at any level of the organization if all they have been taught and rewarded for is applying set procedures to set problems."[22]  He indicated if given a choice, people will usually deal first with those types of problems that are more routine and repetitive before dealing with those that are unique and require creative thought.

While new and changing situations prompt the need for creative problem solving, it is leadership that will likely have an impact on organizational performance when organizations deal with novel and challenging problems.[23]

## Problem Solving and Leadership

The ability to solve problems is seen as a prerequisite of leadership.[24]  Leaders must also learn to lead creatively to be successful in an age of accelerating change and global competition.[25]  The ability to anticipate how change will impact the organization and the capacity to identify strategies to circumvent restrictions imposed by existing social relationships and technological operations may represent necessary components of creative problem solving in organizations.[26]  In their book, *Leaders,* Bennis and Nanus identified creativity as an important component of effective leadership.[27]  A study conducted for the U.S. Army on requisite cognitive skills for strategic leadership found the following cognitive skills to be critical to effective functioning at the highest executive levels: mapping ability, problem management/solution, long-term planning, and creative thinking.[28]  Leaders are constantly faced with the challenge of

solving organizational problems that are complex, lack adequate information and resources, and must be resolved quickly.

Mumford, Zaccaro, Harding, Jacobs and Fleishman proposed a skills-based model of leader performance and asserted the capability of a leader ultimately depends on his or her ability to formulate and implement solutions to novel, ambiguous, and ill-defined problems, which inevitably arise in organizations.[29] Their leadership performance model is based on three critical skills: 1) complex problem-solving skills, 2) solution construction skills, and 3) social judgment skills.[30] Mumford et al. argued that:

> The skills needed to solve organizational leadership problems include complex creative *problem-solving skills* associated with identifying problems, understanding the problem, and generating potential solutions; *social judgment skills* associated with the refinement of potential solutions and the creation of implementation frameworks within a complex organization setting; and *social skills* associated with motivating and directing others during solution implementation.[31]

A series of leadership studies were conducted using a large cross-sectional sample of U.S. Army officers that appear to support the assertions of Mumford et al. One study assessed criterion-related validity of constructed response measures of key leadership capabilities in Army officers and found that complex problem-solving skills, social judgment skills, and leader knowledge were indeed predictive of leader achievement and quality of solutions to ill-defined problems.[32] Another study examined the acquisition of requisite leadership skills over leaders' careers and found leader expertise, problem solving skills, systems skills, and social skills increased as they progressed in their careers.[33] The findings in this study supported other research that hypothesized "higher levels of creative problem-solving skills and complex social judgment skills are increasingly required as leaders move through their careers."[34] Another study that examined executive leadership in the U.S. Army indicated that the development of cognitive skills such as creative thinking, decision-making, and strategic problem solving

become increasingly more important as leaders ascend the organizational hierarchy and are skills that can be improved through targeted training.[35]   Training and assignments that introduce complex, novel, ill-defined problems and hands-on experience in solving related problems appear to contribute to the acquisition of these skills.[36]

## Acquisition of Problem Solving Knowledge and Skills

One of the easiest and quickest ways to increase the level of innovation in an organization is to develop people's skills in generating multiple solutions to problems.[37]   Texas Instruments Incorporated integrated creative problem solving into their culture and assert that focusing on teaching personnel to unlock creativity has a direct effect on how efficiently and effectively problems are solved.[38]   Upon investigating the effects of training on the development of creativity and problem finding abilities in business people, Fontenot found training programs effective in developing skills that promoted creativity and creative problem finding.[39]   According to Fontenot, many American businesses complain that their managers and employees have poor problem solving skills, which she attributes to an educational system that undervalues those types of skills.[40]   Thus, it is up to business organizations to remedy the effects of underdeveloped creativity and problem-solving skills experienced through education and raise the levels of innovation in the business world.[41]   According to Isaksen and Parnes, "Learning which promotes the development of creative thinking and problem-solving skills is important for a society with an emphasis on democracy and innovation."[42]   They also noted that creative thinking is both a skill and an innate ability that can be developed, stimulated, and nourished through education and training.[43]

Basadur examined how creative problem solving could be increased and managed in organizations and noted the importance of training in overcoming shortcomings commonly

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found in organizations.[44]  He implied problems and inadequacies are found in all phases of

problem solving—problem finding, problem solving, and solution implementation.  For example,

in problem finding he noted people sometimes lack the initiative to seek out problems,

prematurely assume a problem can't be solved, evaluate before fully investigating the problem,

assume facts about situations and people based on preconceived notions, and place too much

emphasis on solutions rather than defining the problem.[45]  He indicated that people traditionally

have been taught to be very logical and this affects problem solving because of the tendency to

think that every problem must have one right answer.[46]  Basadur also observed that

competitiveness in organizations, the desire to succeed, and fear of the unknown conspire to

inhibit implementing creative solutions.[47]  He concluded that thinking skills and attitudes which

make the creative problem solving process work can be learned, nurtured, and managed in

organizations.[48]

While a leader's performance may ultimately depend on his or her ability to solve novel and

ill-defined organizational problems, the quality of the solutions to these problems may rely on

whether the leader possesses the requisite knowledge and a more complex set of skills.[49]  Klein

noted the importance of drawing on experience in order to define problems and generate novel

courses of action.[50]  Mumford, Marks, et al. indicated that studies of skill acquisition have

focused on either acquiring skills as a function of practice or through experience, yet both appear

to coalesce into the following coherent process:

> Initially, people must acquire base concepts, learn what is expected of them, and
> apply these concepts in well-structured, relatively concrete situations.  Next, these
> concepts must be elaborated and applied in more complex settings as people begin
> independent problem-solving and learn to apply different concepts in different
> settings.  Finally, rapid integration of knowledge drawn from multiple sources and
> practice allows people to address complex, rapidly unfolding problems.[51]

They concluded that training interventions must be tailored to current developmental needs in order to achieve optimal effects in the acquisition of requisite skills and expertise.[52]  Although building upon prior experience is key to learning new skills, Basadur warns that creativity can be stifled if too much faith is put into past experiences.[53]

Teaching people to think and solve problems is a daunting task.  The literature is replete with conflicting ideas on the acquisition of creative problem solving skills.  Frederiksen conducted an extensive review of problem solving and creativity research, which included suggestions by cognitive theorists for instructional methods and strategies.[54]  He indicated there was disagreement among theorists whether problem-solving processes should be taught explicitly or to allow the learners to discover them.  He also pointed out "as we go into domains where problems are increasingly ill-structured, we can be much less certain about the adequacy of our knowledge.  We know little about how to teach students to develop representation of ill-structured problems, to develop plans for solving such problems, or to employ appropriate strategies or heuristic approaches."[55]  Klein noted the inadequacy of using stage models to solve problems, particularly when the steps are followed in a linear sequence to solve ill-defined problems.[56]  He surmised that rational problem-solving methods "do not prepare you to improvise, act without all of the relevant information, or cope with unreliable data or shifting conditions.  They do not prepare you to learn about the goals throughout the problem-solving process."[57]

Whereas Frederiksen recommended the use of general skills, processes, and strategies for instruction with ill-structured problems, a study conducted by Morse and Morse offered empirical evidence to suggest learning strategy instruction might be made more efficient by tailoring the strategy to the problem type or domain.[58]  They found that previous training in

problem solving strategies had an impact on solving convergent problems used in the study but no impact on the divergent problems. [59]

According to Fisher and Ellis convergent thinking is generally taught and learned in contemporary classrooms, while divergent thinking can only be learned through experiences which are novel, creative, and unexpected.[60]  Firestien noted many creative problem solving training programs have focused on divergent abilities, thus neglecting convergent abilities.[61] Both are considered important and complement each other.[62]  Klemm stated, "Creative process requires more than originality.  Creative people think out carefully what they are looking for, and they clarify the reason for their reactions to emerging ideas."[63]

Rickards presented an overview of creativity training programs for graduate students and business professionals that evolved over a 17-year period at the Manchester Business School, United Kingdom.[64]  Creative education in the classroom as well as professional workshops came in the form of one-day professional trainings, three-day training programs, or ten-day "Acquiring Creative Problem–Solving Skills" programs.  The objectives for the one-day program were to raise awareness about the nature of industrial creativity and increase awareness of personal capacity for creative action.  He concluded that benefits of the one-day program were likely to decline rapidly if there were no reinforcing factors in the workplace.  The three-day training programs concentrated on awareness, creative problem solving skill acquisition, and implementing change.  According to Rickards, results from the three-day program might be achieved if participants brought real-life problems to the workshops.  He also indicated the need to train a large number of people to establish formal and informal contacts as a prerequisite to achieve success with shorter training venues.  The ten-day program was an elective for first-year MBA students offered one day a week for ten weeks.  It expanded on the three-day program to

include guest speakers, more practical exercises, and culminated in a project working for industrial clients. This program saw tangible results in the form of corporate products as well as changes in participants' behaviors and problem solving strategies. Hence, for training to achieve superior results, it must go beyond understanding to change attitudes and behaviors.[65] The training experiences observed over the 17-year period led Rickards to conclude that measurable impacts can be achieved through creativity training, training of an experiential nature can lead to personal learning gains and progress on real problems, and "courses should confront participants with real open-ended problems with which individuals are personally involved."[66]

A study conducted by the Center for Creative Leadership found that learning has to have a direct bearing on what an executive wants to learn and should have relevance to actual challenges encountered on the job.[67] Another study investigated the effect of training on the development of autonomous ethical problem solving capacity in business people and found the use of real-life problems and situations important to internalizing the instruction.[68] In his study of executive development in U.S. Army officers, Zaccaro indicated that leadership development curriculum should challenge the limits of current frames of reference and encourage students to construct new understandings of their environment.[69] In other words, the curriculum should stimulate a change in how the students think, feel, and behave.

Isaksen and Parnes surveyed 150 curriculum planners on their knowledge and attitude in the development of creative thinking and problem solving skills curricula.[70] When asked to list three creative thinking techniques that provided them the most success, the most popular techniques listed could be classified as divergent functions. The second most popular responses fell into the category of complex thinking and feeling processes. Very few found success with techniques that could be categorized at the level of involvement in real challenges. Isaksen and Parnes

hypothesized lower-level cognitive methods may have been used because they are easier to define, describe, plan for, and evaluate.[71]

A constantly changing environment requires leaders to think and act differently. Innovative problem solving is a critical cognitive skill leaders need to tackle the complex and ill-defined problems inherent in leadership and dynamic organizations. It's a skill that is acquired through training and experience; however, the timing and quality of those developmental interventions is important to becoming a truly innovative problem solver.

## Notes

[1] Norman Frederiksen, "Implications of Cognitive Theory for Instruction in Problem Solving," *Review of Educational Research* 54, no. 3 (Fall 1984): 363.

[2] Quoted in Joan Markessini, *Strategic Leadership in a Changing World Order: Requisite Cognitive Skills,* ARI Research Note 95-36 (Location: United States Army Research Institute for the Behavioral and Social Sciences, April 1995), 43.

[3] Gerard J. Puccio, "Why Study Creativity?" on-line, Internet, 11 November 2000, available from http://www.buffalostate.edu/~creatcnt/puccio_article.html

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[6] Gerard J. Puccio, "Why Study Creativity?" on-line, Internet, 11 November 2000, available from http://www.buffalostate.edu/~creatcnt/puccio_article.html

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[8] Ibid.

[9] John S. Dacey, *Fundamentals of Creative Thinking* (Lexington, Mass: Lexington Books, 1989), 111.

[10] Charlene Marmer Solomon, "Creativity Training," *Personnel Journal* (May 1990): 67.

[11] Ibid.

[12] Min Basadur, "Managing the Creative Process in Organizations," in *Problem Finding, Problem Solving, and Creativity,* ed. Mark A. Runco (Norwood, N.J.: Ablex Publishing Corporation, 1994), 237-8.

[13] Ibid.

[14] Ibid.

[15] Michael D. Mumford, Deborah L. Whetzel, and Roni Reiter-Palmon, "Thinking Creatively at Work: Organization Influences on Creative Problem Solving," *Journal of Creative Behavior* 31 no. 1 (First Quarter 1997): 8.

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[16] Min Basadur, "Impacts and Outcomes of Creativity in Organizational Settings," in *Nurturing and Developing Creativity: The Emergence of a Discipline,* ed. Scott G. Isaksen et al. (Norwood, N.J.: Ablex Publishing Corporation, 1993), 278-312.

[17] Ibid., 278-9.

[18] Ibid., 288.

[19] Ibid.

[20] Ibid.

[21] Ibid.

[22] Ibid.

[23] Michael D. Mumford, Stephen J. Zaccaro et al., "Leadership Skills for a Changing World: Solving Complex Social Problems," *Leadership Quarterly* 11 no. 1 (Spring 2000): 14.

[24] LtCol Howared E. Snow III, "Lets Refine Our Critical Thinking Skills," *Marine Corps Gazette,* September 1999, 39.

[25] Min Basadur, "Impacts and Outcomes of Creativity in Organizational Settings,"303.

[26] Mumford, Whetzel, and Reiter-Palmon, 12.

[27] Warren Bennis and Burt Nanus, *Leaders* (New York: Harper & Row, Publishers, 1985), 1-43.

[28] Joan Markessini, *Strategic Leadership in a Changing World Order: Requisite Cognitive Skills,* ARI Research Note 95-36 (Location: United States Army Research Institute for the Behavioral and Social Sciences, April 1995), 1-75.

[29] Mumford, Zaccaro et al., 15-17.

[30] Ibid., 11-35.

[31] Ibid., 26.

[32] Mary Shane Connelly et al., "Exploring the Relationship of Leadership Skills and Knowledge to Leader Performance," *Leadership Quarterly* 11 no. 1 (Spring 2000): 65-87.

[33] Michael D. Mumford, Michelle A. Marks et al. "Development of Leadership Skills: Experience and Timing," *Leadership Quarterly* 11 no. 1 (Spring 2000): 87-114.

[34] Mumford, Zaccaro et al., 25.

[35] Stephen J. Zaccaro, *Models and Theories of Executive Leadership: A Conceptual/Emprical Review and Integration*, U.S. Army Research Institute for the Behaviorial and Social Sciences, October 1996, 151.

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[37] James M. Higgins, "Training 101 Creating Creativity," *Training & Development,* November 1994, 11.

[38] Charlene Marmer Solomon, "Creativity Training," *Personnel Journal,* May 1990, 70-71.

[39] Nancy A. Fontenot, "Effects of Training in Creativity and Creative Problem Finding Upon Business People," *The Journal of Social Psychology* 133 no. 1 (1933):20.

[40] Ibid.

[41] Ibid.

[42] Scott G. Isaksen and Sidney J. Parnes, "Curriculum Planning for Creative Thinking and Problem Solving," *The Journal of Creative Behavior* 19 no. 1 (First Quarter 1985): 2.

[43] Ibid., 4.

[44] Basadur, "Managing The Creative Process In Organizations," 254-5.

[45] Ibid., 255.

**Notes**

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[48] Ibid., 257.

[49] Mumford, Marks et al., 108.

[50] Gary Klein, *Sources of Power How People Make Decisions* (Cambridge, Mass:The MIT Press, 1998), 141.

[51] Ibid., 89.

[52] Ibid., 100.

[53] Basadur, "Managing The Creative Process In Organizations," 256.

[54] Fredricksen, 363-407.

[55] Ibid., 396.

[56] Klein, 127-130.

[57] Ibid., 143.

[58] Linda W. Morse and David T. Morse, "The Influence of Problem-Solving Strategies and previous Training on Performance of Convergent and Divergent Thinking," *Journal of Instructional Psychology* 22 no. 4 (December 1995): 348.

[59] Ibid.

[60] Aubry B. Fisher and Donald G. Ellis, *Small Group Decision Making, Communication and the Group Process* (New York: McGraw Hill Publishing Co., 1990), 167-168.

[61] Roger L. Firestien, "The Power of Product," in *Nurturing and Developing Creativity: The Emergence of a Discipline,* ed. Scott G. Isaksen et al. (Norwood, N.J.: Ablex Publishing Corporation, 1993), 268-269.

[62] Fisher and Ellis, 167.

[63] William R. Klemm, "Leadership: Creativity and Innovation," in *Concepts for Air Force Leadership, AU 24,* ed. Richard I. Lester and A. Glenn Morton (Maxwell AFB, Ala: Air University College of Aerospace Doctrine, Research and Education, 1996), 405.

[64] Tudor Rickards, "Creativity From a Business School Perspective: Past, Present, and Future," in *Nurturing and Developing Creativity: The Emergence of a Discipline,* ed. Scott G. Isaksen et al. (Norwood, N.J.: Ablex Publishing Corporation, 1993), 155-176.

[65] Basadur, "Managing The Creative Process In Organizations," 244.

[66] Rickards, 170.

[67] Jay A. Conger and Beth Benjamin, *Building Leaders: How Successful Companies Develop the Next Generation* (San Francisco: Jossey-Bass Publishers, 1999), 13-14.

[68] Iordanis Kavathatzopoulos, "Training Professional Managers in Decision-Making About Real Life Business Ethics Problems: The Acquisition of the Autonomous Problem-Solving Skill," *Journal of Business Ethics* 13 (1994): 379-386.

[69] Zaccaro, 151, 410.

[70] Scott G. Isaksen and Sidney J. Parnes, "Curriculum Planning for Creative Thinking and Problem Solving," *The Journal of Creative Behavior* 19 no. 1 (First Quarter 1985): 1.

[71] Ibid., 11-13.

# Chapter 3

# Officer Professional Military Education

*Without intellectual change, there is no real change in doctrine, organizations, or leaders.*

—Joint Vision 2020

## Continuum of Education

The USAF Continuum of Professional Military Education Strategic Guidance (CESG) provides the overall direction for Air Force officer PME curricula, clarifying the courses and programs all officers are expected to take as they progress through their careers.[1] The CESG identifies four military education levels that signify different developmental phases in an officer's career: (1) Precommissioning-level, (2) Primary-level, (3) Intermediate-level, and (4) Senior-level. Programs at the U.S. Air Force Academy and Air Force Officer Accession Training Schools (AFOATS) comprise the precommissioning-level. AFOATS consists of the Reserve Officer Training Course (ROTC) and the Officer Training School (OTS). The primary-level includes the Squadron Officers College (SOC) and Company Grade Officers Professional Development Course. The intermediate-level is comprised of Air Command and Staff College (ACSC) and the senior-level of the continuum encompasses the Air War College (AWC).

The curriculum at each level should build upon the prior level and serve as a foundation for the next level while focusing on the developmental requirements of the officer at that point in his

or her career.[2]  Although the CESG guides what the core curriculum is for each of the schools, it is not prescriptive in nature.  The five core areas of study that provide the foundation of officer PME are:

1.  Profession of Arms
2.  Military Studies
3.  International Security Studies
4.  Communication Studies
5.  Leadership Studies

Problem solving is an educational objective found in Communication Studies and Leadership Studies.  For example, a specific primary-level learning objective in Communication Studies is to "comprehend basic systematic problem-solving techniques or processes."[3]  Also found under Communication Studies is intermediate-level emphasis "on the analytical capabilities, creative thought processes, and problem-solving skills needed at the squadron command level."[4]  An intermediate-level specific learning objective in Leadership Studies is to "apply critical thinking to decision making and problem solving scenarios."[5]

The rest of this chapter will provide an overview of how problem solving is integrated into the curricula of those in-resident PME schools located at Maxwell Air Force Base, Alabama.  Although OTS is also an in-resident school located at Maxwell Air Force Base and included in the continuum of education, it actually falls into the realm of training, which focuses more on teaching individuals "how to do" as opposed to "how to think."[6]  Therefore, OTS is not included in this study.

**Squadron Officer College (SOC)**

SOC provides professional education for company grade officers and DoD civilian equivalents and focuses on preparing them for leadership roles at the tactical level.  The Aerospace Basic Course is a four-week course designed for newly commissioned lieutenants,

with approximately one year or less of active duty service, and selected civilians. Squadron Officer School is a five-week course geared towards Captains with five to seven years of experience, and civilian equivalents.

**Aerospace Basic Course (ABC).** As the first course in officer PME, ABC is an indoctrination of the Air Force way of life and focuses on the role of airmen and teamwork. A one-hour block of instruction entitled *Fundamentals of Team Building and Problem Solving* introduces the students to a six-step problem solving process at the beginning of the course. The students participate in three separate team challenges and one joint team problem solving exercise where they can apply what they learned in seminar; however, the emphasis is placed on team building. Each team challenge consists of various runs and problem-solving events over a three-mile course within one hour and twenty minutes. The joint team problem solving is a two and one-half hour event and is a squadron level exercise that incorporates a variety of physical and mental challenges.

**Squadron Officer School (SOS).** SOS introduces the APTEC (Analyze, Plan, Train, Execute, and Critique) model as a leadership planning and organizational tool. A five-step problem solving process (identify and understand mission/problem, gather and use data, generate solutions, test and evaluate solutions, and choose and modify solution) is discussed in the Analyze portion of the model. The model is introduced in a one-hour lecture using case studies of military leaders, and then further discussed in seminar for approximately one and half hours. Numerous opportunities are provided throughout the course to apply these concepts, as well as provide and give feedback on their application, to a variety of unique and novel situations that are physically and mentally challenging to include: indoor and outdoor team leadership problems, Flickerball, and Project X. Flickerball is an outdoor game that incorporates a complex

set of rules that forces a team to work together using strategic planning and problem solving rather than athletic ability to score points. Project X is an outdoor experiential learning environment where the seminar groups are given a scenario they must solve and accomplish with the props provided and within a prescribed time limit. In the course of a day they encounter seven different scenarios and environments.

**Air Command and Staff College (ACSC)**

ACSC is a 10-month program for majors and civilian equivalents and focuses on warfighting within the context of operational art. The curriculum is geared towards preparing students for positions of higher responsibility, with an emphasis on teaching the necessary skills to future squadron commanders. The intent of the curriculum at ACSC is to "Teach students to think seriously about leadership, war, the profession of arms, and aerospace power, preparing them for the challenge of creating innovative solutions to operational problems."[7] During the year the following instruction, which is directly related to problem solving, is provided within the Leadership and Command and Communication Studies courses: *Critical Thinking for Effective Communication* (one hour lecture), *Applied Critical Thinking: Case Studies* (two hour seminar), *Creativity and Innovation* (one and a half-hour seminar), and *Anticipating Profound Change* (one hour seminar).

The first half of the school year has a theoretical foundation, whereas the second half puts theory into practice. Opportunities to apply innovative problem solving are found throughout the curriculum through research papers, group projects, and exercises. The school year culminates with a wargame-based course that involves an exercise that allows students to apply creative solutions to the execution of an air campaign.

**Air War College (AWC)**

AWC is a 10-month school that is geared towards educating Lieutenant Colonels and DoD Civilian equivalents to lead at the strategic level in the employment of air and space forces, including joint operations, in support of national security.  Problem solving is perceived as a skill that has already been acquired and the focus is application of skills in addressing challenges presented in the curriculum.  Except for one elective, there are no units of instruction on any aspect of problem solving.  The elective, *Psychology of Decision Making*, is offered one time during the year and addresses how people make decisions using case studies, seminar discussion, and lecture.

The AWC curriculum provides a "framework for organizing thoughts" and prepares students to be able to handle a new environment.[8]  The first half of the year builds the theoretical foundation through the following courses: *Strategy, Doctrine and Airpower; International Securities Studies;* and *Leadership Studies*.  The second half of the year is spent posing a series of problems out in the future through the *Warfighting Course.*

**Notes**

[1] Continuum of Officer Professional Military Education Strategic Guidance, 1998.
[2] Ibid., 7.
[3] Ibid., 16.
[4] Ibid.
[5] Ibid., 19.
[6] Air Force Doctrine Document (AFDD) 2-4.3, *Education and Training*, 9 September 1998, 2.
[7] Dr. Richard Muller, Dean of Education and Curriculum, Air Command and Staff College, Overview briefing provided at ACSC Civilian Orientation, June 2000.
[8] Dr. Stephen Fought, Dean of Academics, Air War College, interviewed by author, 8 March 2001.

# Chapter 4

# Analysis

*No problem can be solved from the same consciousness that created it; we must learn to see the world anew.*

—Albert Einstein

Air Force Doctrine on education and training identifies two objectives for education programs: (1) to prepare airmen to find solutions to ill-defined problems and (2) to "form a continuous process in which educational exposure builds upon previous experience." [1] This chapter will address the questions presented in the introduction, and, as a result, evaluate how well officer PME is meeting Air Force objectives.

## Research Questions

### Are USAF Officer PME Curricula Offering Innovative Strategies for Solving Problems?

Along the PME continuum, the primary-level schools appear to offer more opportunities to learn innovative problem solving skills and strategies. Both ABC and SOS provide students with numerous opportunities to reinforce classroom instruction with experiential learning projects and exercises that provide novel and challenging problems, thus provoking innovative problem solving.

Of the PME schools, SOS offers the most inclusive curriculum of learning problem solving skills and innovative strategies. Problem solving strategies are integrated throughout the entire

curriculum. The students are introduced to different planning and leadership processes and models that include problem solving strategies, which are used from the moment they arrive to organize their flights and latter to accomplish flight missions and exercises. SOS also provides more opportunities for innovative problem solving than the other PME schools. Students participate for two full days in Project X, an outdoors experiential learning obstacle course. Students are challenged to solve a problem within time constraints, limited resources, and in an unfamiliar environment, thus forcing them think and act differently in order to succeed. As the day goes on they encounter different scenarios of varying degrees of difficulty and become more proficient problem solvers. The real problems in which students are personally engaged during Project X are representative of the type of training experiences Rickards noted could lead to personal learning gains in creative problem solving.[2]

Although ACSC offers a course on creativity and innovation, it is very short in duration and concentrates more on enhancing awareness than acquisition of skills. The curriculum that provides specific instruction in creativity and problem solving at ACSC falls into the same category Isaksen and Parnes found to be prevalent among curriculum planners they surveyed on techniques used for creative thinking and problem solving.[3] Using the Creative Learning Model to categorize the responses they discovered most fell into Level One, which is learn and use basic thinking tools.[4] Level Two is learn and practice a systematic problem solving process and Level Three is working with real problems.[5] The ACSC curriculum on creativity and problem solving falls within Level One because Level Two indicates the creative and thinking tools acquired in Level One are extended and applied in meaningful ways.[6] A bridge or connection between the creativity and problem solving instruction and the rest of the ACSC curriculum was not established, thus it failed to provide meaningful application for the students. As was noted in

the previous chapter, there are opportunities in the overall curriculum to exercise innovative problem solving, yet the connection between the direct instruction and the rest of the curriculum was not made. It should also be noted that although opportunities exist to apply innovative problem solving, there is no emphasis to do so.

**Along the PME Continuum, Is There A Difference In What Is Offered In Each School And Is It Appropriate For The Level Of The Officer's Experience?**

The most striking differences between the primary-level schools and intermediate- and senior-level schools are the more hands-on, experiential, and group problem solving experiences found in ABC and SOS. Their curriculum offers more physical and mental challenges related to innovative problem solving, which is appropriate due to the experience level of these students. The ACSC and AWC curriculum focuses more on the individual student and is more on the cerebral level.

A basic level of instruction in problem solving strategies and skills is provided in ABC; however, at this point, students have very little prior experience with the Air Force and the primary emphasis at this school is indoctrinating members into the Air Force way of life. Consequently, these students have a limited knowledge base and little experience from which to develop complex problem solving skills. According to Mumford, Zaccaro, Connelly, Shane, and Marks, "exercises intended to facilitate the application of requisite problem-solving and solution construction skills are unlikely to prove of any great value early in leaders' careers when leaders lack the principal-based knowledge structures needed for effective application of these skills."[7]

As noted above, problem solving is integrated throughout the SOS curriculum and this seems appropriate due to the heavy emphasis on leadership at the tactical level. As Captains with five to seven years of service, students have acquired a solid knowledge base of their Air Force career fields and are placed in positions of responsibility and leadership. Thus, a training

program that prompts students to deal with more complex problems helps them to acquire the requisite skills needed to deal with more challenging and complex problems and situations in their careers.

The limited course offerings at ACSC and virtually no training in creative problem solving at the AWC conflict with the notion that higher levels of complex problem solving skills are needed as leaders progress through their careers[8]. The absence of coursework in this area also implies there is no need for additional training, that members already have the requisite skills to successfully deal with complex, ill-defined, and novel problems. Officers selected for these two schools are among the top 20% of their peer groups and are considered to be the future leaders of the Air Force. These are officers who had to have done very well in their careers, yet some of the shortcomings Basadur identified in organizations that necessitate the need for training in creative problem solving may be applicable.[9] The organizational environment of the military promotes logical thinking, reliance on past experiences, and competitiveness in career advancement; all potential shortcomings in implementing problem solving and creative solutions.[10] Thus, developmental interventions at the mid- and senior-level schools would appear to be important in maturing the innovative thought processes in future Air Force leaders.

In sum, education programs that prepare airmen to find solutions to ill-defined problems seem to be more prevalent at the primary level of the continuum of education. As far as building upon previous experience, there seems to be a gap between SOS and both ACSC and AWC. A good foundation in innovative problem solving is built in SOS, but is not expanded upon and further developed at higher levels in the PME continuum.

## Notes

[1] Air Force Doctrine Document (AFDD) 2-4.3, *Education and Training*, 9 September 1998, 6.

[2] Tudor Rickards, "Creativity From a Business School Perspective: Past, Present, and Future," in *Nurturing and Developing Creativity: The Emergence of a Discipline,* ed. Scott G. Isaksen et al. (Norwood, N.J.: Ablex Publishing Corporation, 1993), 155-176.

[3] Scott G. Isaksen and Sidney J. Parnes, "Curriculum Planning for Creative Thinking and Problem Solving," *The Journal of Creative Behavior* 19 no. 1 (First Quarter 1985): 1.

[4] Donald J. Treffinger, Scott G. Isaksen, and K. Brian Dorval, "Creative Problem Solving: An Overview," in *Problem Finding, Problem Solving, and Creativity,* ed. Mark A. Runco (Norwood, N.J.: Ablex Publishing Corporation, 1994), 231-4.

[5] Ibid., 233.

[6] Ibid.

[7] Michael D. Mumford, Stephen J. Zaccaro, et al., "Leadership Skills: Conclusion and Future Directions," *Leadership Quarterly* 11 no. 1 (Spring 2000): 166.

[8] Michael D. Mumford, Michelle A. Marks et al. "Development of Leadership Skills: Experience and Timing," *Leadership Quarterly* 11 no. 1 (Spring 2000): 87-114.

[9] Min Basadur, "Managing the Creative Process in Organizations," in *Problem Finding, Problem Solving, and Creativity,* ed. Mark A. Runco (Norwood, N.J.: Ablex Publishing Corporation, 1994), 254-7.

[10] Ibid.

# Chapter 5

# Conclusion

*Once we rid ourselves of traditional thinking we can get on with creating the future.*

—James Bertrand

To meet the demands of a dynamic and changing world environment requires Air Force leaders capable of innovative thought and action. An organization transformed by change is faced with problems that are ambiguous, complex, and ill-defined. Logical as well as creative thought processes must converge for a leader to deal effectively with these novel problems. Although creative or innovative problem solving is often perceived as a rare talent, it is a cognitive skill and innate ability that can be nurtured, developed, and stimulated through education and training. Air Force professional military education (PME) has in fact embraced the concept of developing and reinforcing creative thinking skills and sound problem solving abilities throughout an officer's career.[1] With these acquired skills, "Leaders should be able to articulate ideas that are both visionary and compelling—visionary in the sense of anticipating problems and recognizing solutions, and compelling in the sense of communicating the needs of the modern military."[2]

While Air Force PME does a good job of providing curricula that is based on the developmental and experiential level of the students, opportunities for acquiring innovative strategies for solving problems are more prevalent in the primary-level schools. Whereas the

acquisition of innovative problem solving skills is integrated throughout the primary-level curriculum, the emphasis in the middle-level curriculum is on enhancing awareness through brief seminars or lectures, rather than acquisition of innovative problem solving skills and strategies. Senior level curriculum emphasizes application rather than acquisition of innovative problem solving skills because it is assumed that officers at that point in their careers have already acquired these skills. Thus, the timing of developmental strategies concerning innovative problem solving is on target, but the quality may need to be enhanced.

To affect a change in how ACSC students define problems, solve problems, and implement solutions requires more than just a broad-brush overview of creativity and problem solving. Rickards noted that training could lead to changes in students' behaviors and problem solving strategies if students are confronted with real open-ended problems in which they are personally involved.[3] Using a problem-based approach to address leadership issues, where each seminar tackles a real-world problem over an extended period of time, may affect attitudinal and behavioral change more so than a brief lecture or seminar. Emphasizing creative problem solving in other areas of the curriculum would also reinforce those skills needed to solve ill-defined problems and to articulate ideas that are both visionary and compelling.

However, without further research it can't be concluded that more coursework on innovative problem solving is needed at ACSC and AWC. Recommendations for further research include evaluating pre- and post-problem solving skills of SOS students to better evaluate the effectiveness of the training interventions in the SOS curriculum. Evaluating incoming ACSC and AWC students on problem solving skills would also help determine if there was an actual need to reinforce or broaden their skills. Research has been conducted on developing just such a tool for military leadership. Marshall-Mies, Fleishman, Martin, Zaccaro, Baughman, and McGee

developed and tested an on-line computer-based assessment tool that measured metacognitive problem solving skills in senior military leadership and found the instrument reliable in measuring strategic problem solving and decision-making skills.[4]

As the Air Force strives to meet the challenges of a transforming military environment, leaders who are capable of acting and thinking differently will be critical in the 21st Century. Professional military education and training that is responsive to the needs of the future and to the developmental needs of airmen will be key to insuring a successful transformation.

**Notes**

[1] Continuum of Officer Professional Military Education Strategic Guidance, 1998, 5-6.
[2] Ibid., 6.
[3] Tudor Rickards, "Creativity From a Business School Perspective: Past, Present, and Future," in *Nurturing and Developing Creativity: The Emergence of a Discipline,* ed. Scott G. Isaksen et al. (Norwood, N.J.: Ablex Publishing Corporation, 1993), 170.
[4] Joanne C. Marshall-Mies et al., "Development and Evaluation of Cognitive and Metacognitive Measures for Predicting Leadership Potential," *Leadership Quarterly* 11, no. 1 (Spring 2000): 135-154.

## *Glossary*

ABC                       Aerospace Basic Course
ACSC                  Air Command and Staff College
AFOATS            Air Force Officer Accession and Training Schools
AU                         Air University
AWC                    Air War College

BOT                    Basic Officer Training

CESG                 Continuum of Professional Military Education Strategic Guidance

DOD                   Department of Defense

OTS                    Officer Training School

PME                  Professional Military Education

ROTC                 Reserve Officer Training Course

SOC                   Squadron Officer College
SOS                   Squadron Officer School

USAF                 United States Air Force

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